

17. Four digit numbers are formed by using the digits 1, 2, 3, 5 without repetition of digits. How many of them are divisible by 4?

- (a) 120 (b) 24
(c) 12 (d) 6

18. What is the remainder when 2^{120} is divided by 7?

- (a) 1 (b) 3
(c) 5 (d) 6

19. For what value of n is the determinant

$$\begin{vmatrix} C(9,4) & C(9,3) & C(10,n-2) \\ C(11,6) & C(11,5) & C(12,n) \\ C(m,7) & C(m,6) & C(m+1,n+1) \end{vmatrix} = 0$$

for every $m > n$?

- (a) 4 (b) 5
(c) 6 (d) 7

20. If ABC is a triangle, then what is the value of the determinant

$$\begin{vmatrix} \cos C & \sin B & 0 \\ \tan A & 0 & \sin B \\ 0 & \tan(B+C) & \cos C \end{vmatrix} ?$$

- (a) -1 (b) 0
(c) 1 (d) 3

21. What is the number of different matrices, each having 4-entries that can be formed using 1, 2, 3, 4 (repetition is allowed)?

- (a) 72 (b) 216
(c) 254 (d) 768

22. Let $A = \{x \in R : -1 < x < 1\}$. Which of the following is/are bijective functions from A to itself?

- (A) $f(x) = x|x|$
(B) $g(x) = \cos(\pi x)$

Select the correct answer using the code given below:

- (a) A only (b) B only
(c) Both A and B (d) Neither A nor B

23. Let R be a relation on the open interval $(-1, 1)$ and is given by

$R = \{(x, y) : |x + y| < 2\}$. Then which of the following is correct?

- (a) R is reflexive but neither symmetric nor transitive
(b) R is reflexive and symmetric but not transitive
(c) R is reflexive and transitive but not symmetric
(d) R is an equivalence relation

24. For any three non-empty sets A, B, C , what is

$(A \cup B) - \{(A - B) \cup (B - A) \cup (A \cap B)\}$ is equal to?

- (a) Null set (b) A
(c) B (d) $(A \cup B) - (A \cap B)$

25. If a, b, c are the sides of triangle ABC , then what is

$$\begin{vmatrix} a^2 & b \sin A & c \sin A \\ b \sin A & 1 & \cos A \\ c \sin A & \cos A & 1 \end{vmatrix} \text{ equal to?}$$

- (a) Zero (b) Area of triangle
(c) Perimeter of triangle (d) $a^2 + b^2 + c^2$

26. If a, b, c are in AP; b, c, d are in GP; c, d, e are in HP, then which of the following is/ are correct?

- (A) a, c and e are in GP
(B) $\frac{1}{a}, \frac{1}{c}, \frac{1}{e}$ are in GP

Select the correct answer using the code given below:

- (a) A only (b) B only
(c) Both A and B (d) Neither A nor B

27. What is the number of solutions of

$$\log_4(x-1) = \log_2(x-3)?$$

- (a) Zero (b) One
(c) Two (d) Three

28. For $x \geq y > 1$,

$$\text{let } \log_x\left(\frac{x}{y}\right) + \log_y\left(\frac{y}{x}\right) = k,$$

then the value of k can never be equal to

- (a) -1 (b) $-\frac{1}{2}$
(c) 0 (d) 1

29. If $A = \begin{vmatrix} \sin 2\theta & 2\sin^2 \theta - 1 & 0 \\ \cos 2\theta & 2\sin \theta \cos \theta & 0 \\ 0 & 0 & 1 \end{vmatrix}$, then

which of the following statements is/ are correct?

- (A) $A^{-1} = \text{adj}A$
(B) A is skew-symmetric matrix
(C) $A^{-1} = A^T$

Select the correct answer using the code given below:

- (a) A only (b) A and B only
(c) A and C (c) B and C

30. What is the coefficient of x^{10} in the expansion of

$$(1-x^2)^{20} \left(2-x^2 - \frac{1}{x^2}\right)^{-5} ?$$

- (a) -1 (b) 1
(c) 10 (d) Coefficient of x^{10} does not exist

31. If the 4th term in the expansion of $\left(mx + \frac{1}{x}\right)^n$ is $\frac{5}{2}$, then

what is the value of mn ?

- (a) -3 (b) 3
(c) 6 (d) 12

32. If a, b and $c(a > 0, c > 0)$ are in GP, then consider the following in respect of the equation $ax^2 + bx + c = 0$:

- (A) The equation has imaginary roots.
(B) The ratio of the roots of the equation is $1 : \omega$ where ω is a cube root of unity.

- (C) The product of roots of the equation is $\left(\frac{b^2}{a^2}\right)$.

- Which of the statements given above are correct?
 (a) (A) and (B) only (b) (B) and (C) only
 (c) (A) and (C) only (d) (A), (B) and (C)
33. If $x^2 + mx + n$ is an integer for all integral values of x , then which of the following is/ are correct?
 (A) m must be an integer
 (B) n must be an integer
 Select the correct answer using the code given below:
 (a) A only (b) B only
 (c) Both (A) and (B) (d) Neither (A) nor B
34. In a binomial expansion of $(x+y)^{2n+1}(x-y)^{2n+1}$, the sum of middle terms is zero. What is the value of $\left(\frac{x^2}{y^2}\right)$?
 (a) 1 (b) 2
 (c) 4 (d) 8
35. Let $A = \{1, 2, 3, 4, 5\}$ and $B = \{6, 7\}$. What is the number of onto functions from A to B ?
 (a) 10 (b) 20
 (c) 30 (d) 32
36. What is $\frac{\sqrt{3} \cos 10^\circ - \sin 10^\circ}{\sin 25^\circ \cos 25^\circ}$ equal to?
 (a) 1 (b) $\sqrt{3}$
 (c) 2 (d) 4
37. What is $(\sin 9^\circ - \cos 9^\circ)$ is equal to?
 (a) $-\frac{\sqrt{5-\sqrt{5}}}{2}$ (b) $-\frac{\sqrt{5-\sqrt{3}}}{2}$
 (c) $\frac{\sqrt{5-\sqrt{5}}}{2}$ (d) $\frac{\sqrt{5-\sqrt{5}}}{4}$
38. If in a triangle ABC , $\sin^3 A + \sin^3 B + \sin^3 C = 3 \sin A \sin B \sin C$, then what is the value of the determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$;
 where a, b, c are sides of the triangle?
 (a) $a + b + c$ (b) $ab + bc + ca$
 (c) $(a+b)(b+c)(c+a)$ (d) 0
39. If $\cos^{-1}x = \sin^{-1}x$, then which one of the following is correct?
 (a) $x = 1$ (b) $x = \frac{1}{2}$
 (c) $x = \frac{1}{\sqrt{2}}$ (d) $x = \frac{1}{\sqrt{3}}$
40. What is the number of solutions of $(\sin \theta - \cos \theta)^2 = 2$ where $-\pi < \theta < \pi$?
 (a) Only one (b) Only two
 (c) Four (d) No solution
41. ABC is a triangle such that angle $C = 60^\circ$, then what is $\frac{\cos A + \cos B}{\cos\left(\frac{A-B}{2}\right)}$ equal to?
 (a) 2 (b) $\sqrt{2}$
 (c) 1 (d) $\frac{1}{\sqrt{2}}$
42. What is $\sqrt{15 + \cot^2\left(\frac{\pi}{4} - 2\cot^{-1}3\right)}$ equal to?
 (a) 1 (b) 7
 (c) 8 (d) 16
43. What is the value of $\sin 10^\circ \cdot \sin 50^\circ + \sin 50^\circ \cdot \sin 250^\circ + \sin 250^\circ \cdot \sin 10^\circ$ equal to?
 (a) $-\frac{1}{4}$ (b) $-\frac{3}{4}$
 (c) $\frac{3\sin 10^\circ}{4}$ (d) $-\frac{3\cos 10^\circ}{4}$
44. What is $\tan^{-1}\left(\frac{a}{b}\right) - \tan^{-1}\left(\frac{a-b}{a+b}\right)$ equal to
 (a) $-\frac{\pi}{4}$ (b) $\frac{\pi}{4}$
 (c) $\tan^{-1}\left(\frac{a^2-b^2}{a^2+b^2}\right)$ (d) $\tan^{-1}\left(\frac{2ab}{a^2+b^2}\right)$
45. Under which one of the following conditions does the equation $(\cos \beta - 1)x^2 + (\cos \beta)x + \sin \beta = 0$ in x have a real root for $\beta \in [0, \pi]$?
 (a) $1 - \cos \beta < 0$ (b) $1 - \cos \beta \leq 0$
 (c) $1 - \cos \beta > 0$ (d) $1 - \cos \beta \geq 0$
46. In a triangle ABC , $AB = 16$ cm, $BC = 63$ cm and $AC = 65$ cm. What is the value of $\cos 2A + \cos 2B + \cos 2C$?
 (a) -1 (b) 0
 (c) 1 (d) $\frac{76}{65}$
47. If $f(\theta) = \frac{1}{1 + \tan \theta}$ and $\alpha + \beta = \frac{5\pi}{4}$, then what is the value of $f(\alpha)f(\beta)$?
 (a) $-\frac{1}{2}$ (b) $\frac{1}{2}$
 (c) 1 (d) 2
48. If $\tan \alpha$ and $\tan \beta$ are the roots of the equation $x^2 - 6x + 8 = 0$, then what is the value of $\cos(2\alpha + 2\beta)$?
 (a) $\frac{13}{75}$ (b) $\frac{13}{85}$
 (c) $\frac{17}{85}$ (d) $\frac{19}{85}$
49. What is the value of $\tan 65^\circ + 2 \tan 45^\circ - 2 \tan 40^\circ - \tan 25^\circ$?
 (a) 0 (b) 1
 (c) 2 (d) 4

50. Consider the following statements :
- A. In a triangle ABC, if $\cot A \cdot \cot B \cdot \cot C > 0$, then the triangle is an acute angled triangle.
- B. In a triangle ABC, if $\tan A \cdot \tan B \cdot \tan C > 0$, then the triangle is an obtuse angled triangle.
- Which of the statements given above is/are correct ?
- (a) A Only (b) B Only
(c) Both A and B (d) Neither A nor B
51. If (a, b) is the centre and c is the radius of the circle $x^2 + y^2 + 2x + 6y + 1 = 0$, then what is the value of $a^2 + b^2 + c^2$?
- (a) 19 (b) 18
(c) 17 (d) 11
52. If (1, -1, 2) and (2, 1, -1) are the end points of a diameter of a sphere $x^2 + y^2 + z^2 + 2ux + 2vy + 2wz - 1 = 0$, then what is $u + v + w$ equal to ?
- (a) -2 (b) -1
(c) 1 (d) 2
53. The number of points represented by the equation $x = 5$ on the xy -plane is
- (a) Zero (b) One
(c) Two (d) Infinitely many
54. If $\langle l, m, n \rangle$ are the directions cosines of a normal to the plane $2x - 3y + 6z + 4 = 0$, then what is the value of $49(7l^2 + m^2 - n^2)$?
- (a) 0 (b) 1
(c) 3 (d) 71
55. A line through (1, -1, 2) with directions ratios $\langle 3, 2, 2 \rangle$ meets the plane $x + 2y + 3z = 18$. What is the point of intersection of line and plane ?
- (a) (4, 4, 1) (b) (2, 4, 1)
(c) (4, 1, 4) (d) (3, 4, 7)
56. If p is the perpendicular distance from origin to the plane passing through (1, 0, 0), (0, 1, 0) and (0, 0, 1), then what is $3p^2$ equal to ?
- (a) 4 (b) 3
(c) 2 (d) 1
57. If the directions cosines $\langle l, m, n \rangle$ of a line are connected by relation $l + 2m + n = 0$, $2l - 2m + 3n = 0$, then what is the value of $l^2 + m^2 - n^2$?
- (a) $\frac{1}{101}$ (b) $\frac{29}{101}$
(c) $\frac{41}{101}$ (d) $\frac{92}{101}$
58. If a variable line passes through the point of intersection of the lines $x + 2y - 1 = 0$ and $2x - y - 1 = 0$ and meets the coordinate axes in A and B, then what is the locus of the mid-point of AB ?
- (a) $3x + y = 10xy$ (b) $x + 3y = 10xy$
(c) $3x + y = 10$ (d) $x + 3y = 10$
59. What is the equation to the straight line passing through the point $(-\sin \theta, \cos \theta)$ and perpendicular to the line $x \cos \theta + y \sin \theta = 9$?
- (a) $x \sin \theta - y \cos \theta - 1 = 0$ (b) $x \sin \theta - y \cos \theta + 1 = 0$
(c) $x \sin \theta - y \cos \theta = 0$ (d) $x \cos \theta - y \sin \theta + 1 = 0$
60. Two points P and Q lie on line $y = 2x + 3$. These two points P and Q are at a distance 2 units from another point R(1, 5). What are the coordinates of the points P and Q ?
- (a) $\left(1 + \frac{2}{\sqrt{5}}, 5 + \frac{4}{\sqrt{5}}\right), \left(1 - \frac{2}{\sqrt{5}}, 5 - \frac{4}{\sqrt{5}}\right)$
(b) $\left(3 + \frac{2}{\sqrt{5}}, 5 + \frac{4}{\sqrt{5}}\right), \left(-1 - \frac{2}{\sqrt{5}}, 5 - \frac{4}{\sqrt{5}}\right)$
(c) $\left(1 - \frac{2}{\sqrt{5}}, 5 + \frac{4}{\sqrt{5}}\right), \left(1 + \frac{2}{\sqrt{5}}, 5 - \frac{4}{\sqrt{5}}\right)$
(d) $\left(3 - \frac{2}{\sqrt{5}}, 5 + \frac{4}{\sqrt{5}}\right), \left(-1 + \frac{2}{\sqrt{5}}, 5 - \frac{4}{\sqrt{5}}\right)$
61. If two sides of a square lie on the lines $2x + y - 3 = 0$ and $4x + 2y + 5 = 0$, then what is the area of the square in square units ?
- (a) 6.05 (b) 6.15
(c) 6.25 (d) 6.35
62. ABC is a triangle with A(3, 5). The mid-points of sides AB, AC are at (-1, 2), (6, 4) respectively. What are the coordinates of centroid of the triangle ABC ?
- (a) $\left(\frac{8}{3}, \frac{11}{3}\right)$ (b) $\left(\frac{7}{3}, \frac{7}{3}\right)$
(c) $\left(2, \frac{8}{3}\right)$ (d) $\left(\frac{8}{3}, 2\right)$
63. ABC is an acute angled isosceles triangle. Two equal sides AB and AC lie on the lines $7x - y - 3 = 0$ and $x + y - 5 = 0$. If θ is one of the equal angles, then what is $\cot \theta$ equal to ?
- (a) $\frac{1}{3}$ (b) $\frac{1}{2}$
(c) $\frac{2}{3}$ (d) 2
64. In the parabola $y^2 = 8x$, the focal distance of a point P lying on it is 8 units. Which of the following statements is/are correct ?
- (A) The coordinates of P can be $(6, 4\sqrt{3})$
(B) The perpendicular distance of P from the directrix of parabola is 8 units.
- Select the correct answer using the code given below :
- (a) A only
(b) B only
(c) Both A and B
(d) Neither A nor B
65. What is the eccentricity of the ellipse if the angle between the straight lines joining the foci to an extremity of the minor axis is 90° ?
- (a) $\frac{1}{3}$ (b) $\frac{1}{2}$
(c) $\frac{1}{\sqrt{3}}$ (d) $\frac{1}{\sqrt{2}}$

66. Let $\vec{a} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$.

If $\vec{a} \times (\vec{b} \times \vec{a}) = \alpha \hat{i} - \beta \hat{j} + \gamma \hat{k}$, then what is the value of $\alpha + \beta + \gamma$?

- (a) 8 (b) 7
(c) 6 (d) 1

67. If a vector of magnitude 2 units makes an angle $\frac{\pi}{3}$ with

$2\hat{i}$, $\frac{\pi}{4}$ with $3\hat{j}$ and an acute angle θ with $4\hat{k}$ then what are the components of the vector?

- (a) $(1, \sqrt{2}, 1)$ (b) $(1, -\sqrt{2}, 1)$
(c) $(1, -\sqrt{2}, -1)$ (d) $(1, \sqrt{2}, -1)$

68. Consider the following in respect of moment of a force :
(A) The moment of force about a point is independent of point of application of force.

(B) The moment of a force about a line is a vector quantity. Which of the statements given above is/are correct ?

- (a) A only (b) B only
(c) Both A and B (d) Neither A nor B

69. For any vector \vec{r} , what is

$$(\vec{r} \cdot \hat{i})(\vec{r} \times \hat{i}) + (\vec{r} \cdot \hat{j})(\vec{r} \times \hat{j}) + (\vec{r} \cdot \hat{k})(\vec{r} \times \hat{k})$$
 equal to

- (a) $\vec{0}$ (b) \vec{r}
(c) $2\vec{r}$ (d) $3\vec{r}$

70. Let \vec{a} and \vec{b} are two vectors of magnitude 4 inclined at an angle $\frac{\pi}{3}$, then what is the angle between \vec{a} and $\vec{a} - \vec{b}$?

- (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

71. Let $y_1(x)$ and $y_2(x)$ be two solutions of the differential equation $\frac{dy}{dx} = x$. If $y_1(0) = 0$ and $y_2(0) = 4$, then what is

the number of points of intersection of the curves $y_1(x)$ and $y_2(x)$?

- (a) No point (b) One point
(c) Two points (d) More than two points

72. The differential equation, representing the curve $y = e^x(a \cos x + b \sin x)$ where a and b are arbitrary constants, is

- (a) $\frac{d^2y}{dx^2} + 2y = 0$ (b) $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 2y = 0$
(c) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = 0$ (d) $\frac{d^2y}{dx^2} + y = 0$

73. If $f(x) = ax - b$ and $g(x) = cx + d$ are such that $f(g(x)) = g(f(x))$, then which one of the following holds?

- (a) $f(d) = g(b)$
(b) $f(b) + g(d) = 0$
(c) $f(a) + g(c) = 2a$
(d) $f(d) + g(b) = 2d$

74. What is $\int_{-1}^1 (3 \sin x - \sin 3x) \cos^2 x dx$ equal to?

- (a) $-\frac{1}{4}$ (b) 0
(c) $\frac{1}{2}$ (d) $\frac{1}{4}$

75. What are the order and degree respectively of the differential equation

$$\left\{ 2 - \left(\frac{dy}{dx} \right)^2 \right\}^{0.6} = \frac{d^2y}{dx^2}?$$

- (a) 2, 2 (b) 2, 3
(c) 5, 2 (d) 2, 5

76. If $\frac{dy}{dx} = 2e^x y^3$, $y(0) = \frac{1}{2}$ then what is $4y^2(2 - e^x)$ equal to?

- (a) 1 (b) 2
(c) 3 (d) 4

77. Let $p = \int_a^b f(x) dx$ and $q = \int_a^b |f(x)| dx$. If $f(x) = e^{-x}$, then

which one of the following is correct?

- (a) $p = 2q$ (b) $p = -q$
(c) $4p = q$ (d) $p = q$

78. What is $\int_0^{\frac{\pi}{2}} \frac{a + \sin x}{2a + \sin x + \cos x} dx$ equal to?

- (a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$
(c) 1 (d) 0

79. The non-negative values of b for which the function $\frac{16x^3}{3} - 4bx^2 + x$ has neither maximum nor minimum in

the range $x > 0$ is

- (a) $0 < b < 1$ (b) $1 < b < 2$
(c) $b > 2$ (d) $0 \leq b < 1$

80. Which one of the following is correct in respect of

$$f(x) = \frac{1}{\sqrt{|x| - x}} \text{ and } g(x) = \frac{1}{\sqrt{x - |x|}}?$$

- (a) $f(x)$ has some domain and $g(x)$ has no domain
(b) $f(x)$ has no domain and $g(x)$ has some domain
(c) $f(x)$ and $g(x)$ have the same domain
(d) $f(x)$ and $g(x)$ do not have any domain